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The effect of transition metals and other parameters on the coalescence of sputter-deposited silver islands on coated glass*

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Abstract.

Silver thin films were deposited on various base layers using magnetron sputtering. The onset of coalescence of silver islands was observed using in-situ conductivity measurements. The sheet resistance was determined as a function of various deposition parameters such as the type and thickness of the transparent base layer and the presence of small amounts of transition metals. The coalescence of silver islands was determined by a sharp drop of the sheet resistance when the nominal layer thickness was marginally increased. Coalescence occurred typically somewhere in the range 8-16 nm. It was found that the earliest onset of coalescence occurs at the lowest sputtering power (50W). Furthermore, earliest onset occurred for the thinnest of the ZnO:Al4at% base layer (5nm). The main focus of this work was to study the effect of small amounts of transition metals (Ti, Nb, Ta, W, Mo, Zr, Cr, and Ni). It was found that coalescence occurs earlier than without transition metals and in particular the following material-depending conditions promoted early coalescence: titanium (0.1-0.2 nm), tungsten (1.0 nm), molybdenum (0.1 nm), zirconium (0.5 nm), and nickel (0.1-0.2nm). These results can be interpreted using well-known nucleation and growth models and by taking into account that both thermodynamic and kinetic driving forces contribute to film formation at relatively low temperature. The results can be used to further optimize silver-based low-emissivity coatings on glass and plastics.